

Advanced numerical treatment of an accurate SPH method

Laura Antonelli[†], Daniela di Serafino[§], Elisa Francomano[‡], Francesco
Gregoretto[†], Marta Paliaga[‡]

[†] ICAR-CNR, Via P. Castellino 111, Napoli, Italy

[§] University of Campania “Luigi Vanvitelli”, Viale A. Lincoln 5, Caserta, Italy

[‡] University of Palermo, Viale delle Scienze, Palermo, Italy

`laura.antonelli@icar.cnr.it`, `daniela.diserafino@unicampania.it`,

`elisa.francomano@unipa.it`, `francesco.gregoretto@icar.cnr.it`,

`marta.paliaga@unipa.it`

Keywords. IFGT; SPH; GPUs.

The summation of Gaussian kernel functions is an expensive operation frequently encountered in scientific simulation algorithms and several methods have been already proposed to reduce its computational cost. In this work, the Improved Fast Gauss Transform (IFGT) [1] is properly applied to the Smoothed Particle Hydrodynamics (SPH) method [2] in order to speed up its efficiency. A modified version of the SPH method is considered in order to overcome the loss of accuracy of the standard formulation [3]. A suitable use of the IFGT allows us to reduce the computational effort while tuning the desired accuracy into the SPH framework. This technique, coupled with an algorithmic design for exploiting the performance of Graphics Processing Units (GPUs), makes the procedure promising as shown by preliminary numerical simulations.

Acknowledgements.

The authors acknowledge support by INdAM–GNCS Project 2019 “*Kernel-based approximation, multiresolution and subdivision methods and related applications*”. This research has been accomplished within RITA (Research ITALian network on Approximation).

References

- [1] Morariu V.I., Srinivasan B.V., Raykar V.C., Duraiswami R. and Davis L.S. (2008), Automatic online tuning for fast Gaussian summation. *Advances in Neural Information Processing Systems*, Vol. 21, pp. 1113–1120.
- [2] Liu M.B. and Liu G.R. (2010), Smoothed Particle Hydrodynamics (SPH): An overview and recent developments. *Archives of Computational Methods in Engineering*, Vol. 17(1), pp. 25–76.
- [3] Francomano E. and Paliaga M. (2018), Highlighting numerical insights of an efficient SPH method. *Applied Mathematics and Computation*, Vol. 339, pp. 899–915.